State of New Jersey

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BOB MARTIN
Commissioner

May 2, 2017

Suez Water New Jersey Hackensack
200 Lake Shore Drive
Haworth, NJ 07641
Attention: Lynn Marie DeCarlo

Re: Suez Water New Jersey Hackensack (Suez)
PWSID NO. NJ0238001
Conditional Approval of Corrosion Control Treatment

Dear Ms DeCarlo:

The Bureau of Water System Engineering (Bureau) is in receipt of the Corrosion Control Treatment (CCT) Recommendation dated February 2, 2017 for the Haworth Treatment Plant. The CCT is to install a chemical feed of Zinc Orthophosphate to inhibit corrosion in the distribution system.

After review of supporting documentation and analytical results, the Bureau conditionally approves the CCT Recommendation. The basis for the conditional approval is outlined below. Suez Water has not exceeded the lead or copper action level but it opted to install the approved Zinc Orthophosphate feed for CCT in accordance with 40 CFR141.81 (e)(5). It should be noted that, Suez Water already obtained a permit to modify and operate the Haworth treatment plant process from the Bureau in accordance with N.J.A.C. 7:10-11.5, and the permit did highlight that the current pH of 8 is not optimal.

The present treatment process of the Haworth plant includes a pH adjustment using Sodium Hydroxide to adjust the pH to about 8. Suez Water was on a triennial cycle of the lead and copper monitoring schedule; however, all large water systems were placed on standard lead and copper monitoring beginning January 1, 2017. The last full monitoring periods reported to the State database are in 2012 and 2015. The 90th percentile of the lead samples for these periods are 0.0143 and 0.014 parts per million (ppm), just below the action level for lead of 0.015 ppm. The highest five lead concentration locations of the reduced sites in the lead and copper monitoring are shown in the table below. Based on these results, Suez Water has pre-emptively chosen to add a corrosion inhibitor.

5 locations with the highest lead concentrations			
2012		2015	
Site Address	Lead	Site Address	Lead
[redacted] Bogota	0.0378	[redacted] Harrington Park	0.038
[redacted] Harrington Park	0.0292	[redacted]	0.022
[redacted] Teaneck	0.0235	[redacted] Englewood	0.019
[redacted] Demarest	0.022	[redacted] Teaneck	0.018
[redacted] Teaneck	0.0167	[redacted] Edgewater	0.016
90th Percentile	**0.0143**	**90th Percentile**	**0.014**

Per EPA's document "Optimal Corrosion Control Treatment Evaluation Technical Recommendation for Primacy Agencies and Public Water System", water with a pH, between 8 and 8.5 tend to have a low buffer intensity and may have more variable pH within the distribution system whereas water outside this pH range will have a higher buffer intensity and may exhibit less variability in pH level in the distribution. Therefore, understanding the pH range in the distribution system is an important part of maintaining corrosion control.

In summary, Suez Water can use the Zinc Orthophosphate inhibitor proposed but it should be noted that the current pH that Suez Water is maintaining may be inefficient. The Bureau strongly recommends that Suez Water either lower the pH to less than 8 or higher than 8.5; a pH of 7.5 is ideal.

Within 15 days of the date of this letter, Suez Water must inform the Bureau of all consecutive systems that would receive the water treated with zinc orthophosphate and how Suez Water is addressing the potential impacts on these consecutive systems. Suez Water must also outline steps that have been taken and will be taken to minimize potential impacts on the consecutive systems during the addition of the CCT.

The chemical feed is required to be constructed in accordance with Subchapter 11 of the NJ Safe Drinking Water Act, including, but not limited to, N.J.A.C. 7:10-11.12 and N.J.A.C 7:10-11.15(d).

<u>Following installation and operation of the chemical feed, the following conditions are required to be met in addition to the permit conditions:</u>

1. The addition of the chemical feed will not change this system's treatment license classification of T4. The Licensed Operator should continually monitor the facility to demonstrate that the treatment unit is providing compliance with the lead and copper action levels.

   The Licensed Operator shall submit Monthly Operator Reports, as required pursuant to N.J.A.C. 7:10A-1.12(d), to the Bureau no later than 10 days after the end of each month for which data is collected. The Monthly Operator Report shall include, but not be limited to, orthophosphate, pH, dosage of Sodium Hydroxide and daily treated water pumpage.

   The chemical dosage required (not to exceed 10mg/L) should sustain a residual level of 0.5 mg/L or greater in the distribution system. To the extent possible, collect daily orthophosphate residual readings at the point of entry - source water after treatment and report recorded values on the Monthly Operator Reports. The dosage required should sustain pH values of about 7.5 in the distribution system. Collect daily pH readings at the point-of-entry - source water after treatment, and report recorded values on the Monthly Operator Report.

   Daily readings do not need to be performed by a certified laboratory; however, it is strongly recommended that the orthophosphate residual and the pH be analyzed using an objective method (i.e. digital meter) and not a subjective method (i.e. color wheel).

2. Continue to monitor for lead and copper every 6- months (standard monitoring). Based on the current population of 792,713, 100 sampling sites are required to be analyzed for each 6-month monitoring period.

3. Suez Water is currently conducting Follow- up Water Quality Parameter (WQP). Following the installation and operation of the CCT, in accordance with 40 CFR 141.87(c), Suez Water must conduct additional follow up monitoring for two consecutive 6-month beginning January 1st or

July 1st whichever is sooner. This includes beginning biweekly monitoring for Orthophosphate at the Point of Entry. All WQP results must be submitted through E2 or, if sampling is conducted by an approved party, results must be submitted on the WQP Monitoring Report Form for Approved Party. Within 30 days of the date of this letter, Suez Water must also update their WQP sampling plan to reflect the new sampling requirement.

If you have any question about this approval, you can contact Ade Oguntala at (609) 292- 2957 or mailto:ade.oguntala@dep.nj.gov. When contacting the Department please reference the PWSID No. NJ0238001 and Letter No. LCR170002.

Sincerely,

Linda Ofori, Supervisor
Bureau of Water System Engineering

cc: Northern Bureau of Water Compliance and Enforcement
Xenia Feliz, BWSE

#2

CDM Smith

Memorandum

To: Anthony Delescinskis, P.E., SUEZ Water

From: Sandra Kutzing, P.E., CDM Smith Inc.

Date: February 2, 2017

Subject: *Suez Water New Jersey*
Haworth Water Treatment Plant Corrosion Control Test Results

Introduction

SUEZ Water New Jersey (SWNJ) is a privately-owned water utility that provides service to approximately 792,000 residents in 60 municipalities within Bergen and Hudson Counties in Northern New Jersey. SWNJ owns and operates the water system which includes the Haworth Water Treatment Plant (Haworth WTP) and the Oradell Reservoir which is the raw water source for the Haworth WTP.

The Haworth WTP was originally constructed in 1964 as a conventional water treatment plant with a rated capacity of 50 million gallons per day (mgd). In 1989, the Haworth WTP plant was upgraded with ozone and expanded as a direct filtration plant with a reliable capacity of 165 mgd. The plant process was subsequently upgraded in 2010 to include pre-ozonation and dissolved air flotation (DAF) to bring its firm capacity to 187.5 mgd. The current process includes pH adjustment, coagulation, pre-ozonation, mixing, dissolved air flotation, chlorination, and dual media filtration and chloramination.

Presently the Haworth WTP accomplishes corrosion control through pH adjustment with addition of sodium hydroxide (caustic) and monitoring the Langelier Saturation Index with a goal of 0.3. It is estimated that approximately 9,000 lead service connections exist within the Haworth WTP's distribution system, and the current practice has been successful at meeting the action levels set by the Lead and Copper Rule (LCR). However, the most recent round of lead and copper sampling from 51 homes in 2015 concluded the 90th percentile to be 0.014 mg/L, just under the LCR's Action Level of 0.015 mg/L for lead. Supplementing the existing corrosion control practice with a corrosion inhibitor may help to meet the LCR requirements and increase protection of public health.

This memorandum reviews the study performed to evaluate alternatives for improving corrosion control at the Haworth WTP and presents the findings and recommendations.

Corrosion Control Study Overview

The purpose of this study was to perform bench scale metal coupon immersion test to evaluate corrosion control practices at the Haworth WTP. Water samples dosed with two (2) types of corrosion inhibitors (zinc orthophosphate (ZOP) and phosphoric acid (PA)) were exposed to lead, copper and mild steel (representing unlined cast iron pipe) coupons at various phosphate

dosages and varying pH's in glass beakers. Water samples from three (3) different locations in the distribution system were used to evaluate the effectiveness of the two chemicals in reducing lead concentrations in the water samples.

As part of this study, two types of corrosion inhibitors, ZOP and PA, were tested for potential implementation at the Haworth WTP. The ZOP was certified analytical grade, Carus 3200 (11.0 lbs/gal, 30 % PO_4, 1/5 Zinc/PO_4 ratio – SG=1.32). The generic phosphoric acid (PA) was also obtained from Carus.

Four (4) samples were taken from the three (3) different locations in the distribution system as discussed below:

> Location 1 –49 Tappan Road, Harrington Park - near the address where the maximum lead result from the latest LCR sampling occurred. Eighteen (18) samples were taken from this location since Location 1 was evaluated for both PA and ZOP.
>
> Location 2 –190/246 Palisade Avenue, Bogota - in the vicinity of the address where the last round of lead testing indicated a concentration of 0.014 mg/l (milligrams per liter). Nine (9) sample was taken from this location to evaluate ZOP.
>
> Location 3 – 151 Howard Terrace, Leonia - near the address where the lead concentration was in the lower 10 percent of the lead testing results. Nine (9) sample was taken from this location to evaluate ZOP.

Individual testing conditions are summarized in the test matrix in Table 1 below.

Table 1 - Test Matrix Initial Protocol

Location 1 – Distribution System Water Sample (18 total samples)									
Sample ID	L1-0.5-1-Zn	L1-0.5-2-Zn	L1-1.0-1-Zn	L1-1.0-2	L1-1.5-1-Zn	L1-1.5-2-Zn	L1-2.0-1-Zn	L1-2.0-2-Zn	L1-0-Zn
Zinc Orthophosphate (mg/L as PO_4)	0.5	0.5	1.0	1.0	1.5	1.5	2.0	2.0	No addition
pH	7.5	system pH	7.5	system pH	7.5	system pH	7.5	system pH	system pH
Sample ID	L1-0.5-1-0	L1-0.5-2-0	L1-1.0-1-0	L1-1.0-2-0	L1-1.5-1-0	L1-1.5-2-0	L1-2.0-1-0	L1-2.0-2-0	L1-0-0
Phosphoric Acid Concentration (mg/L as PO_4)	0.5	0.5	1.0	1.0	1.5	1.5	2.0	2.0	No addition
pH	7.5	system pH	7.5	system pH	7.5	system pH	7.5	system pH	system pH
Location 2 – Distribution System Water Sample (9 total samples)									

Sample ID	L2-0.5-1-Zn	L2-0.5-2-Zn	L2-1.0-1-Zn	L2-1.0-2-Zn	L2-1.5-1-Zn	L2-1.5-2-Zn	L2-2.0-1-Zn	L2-2.0-2-Zn	L2-0-Zn
Zinc Orthophosphate Concentration (mg/L as PO_4)	0.5	0.5	1.0	1.0	1.5	1.5	2.0	2.0	No addition
pH	7.5	system pH	7.5	system pH	7.5	system pH	7.5	system pH	system pH
Location 3 – Distribution System Water Sample (9 total samples)									
Sample ID	L3-0.5-1-Zn	L3-0.5-2-Zn	L3-1.0-1-Zn	L3-1.0-2-Zn	L3-1.5-1-Zn	L3-1.5-2-Zn	L3-2.0-1-Zn	L3-2.0-2-Zn	L3-0-Zn
Zinc Orthophosphate Concentration (mg/L as PO_4)	0.5	0.5	1.0	1.0	1.5	1.5	2.0	2.0	No addition
pH	7.5	system pH	7.5	system pH	7.5	system pH	7.5	system pH	system pH

A complete description of the test materials, test apparatus and procedures is provided in the "Haworth Water Treatment Plant Corrosion Control Test Protocol" dated August 12, 2016 by CDM Smith which is attached in Appendix A. Figure 1 shows the typical sample set up with the immersed coupons for lead, copper and mild steel for the three sample locations.

Figure 1 – Typical Immersion Sample Setup for Locations 1, 2 and 3

Baseline Water Quality Data

As discussed above, testing was performed at three locations. Baseline water quality testing was performed by Agra Environmental and Laboratory Services (Agra) on September 17, 2016 and by SWNJ on October 4, 2016. The results are presented in Table 2.

As shown in Table 2, there were significant discrepancies in the test results between the two sampling events. The more significant discrepancies are discussed below:

- Location 1 showed a discrepancy in the free and total chlorine measurements between Agra's and SWNJ's samples.
- Location 1, 2 and 3 show a discrepancy in the iron and manganese values between Agra's and SWNJ's samples.
- Location 1 shows a significant discrepancy in the lead concentration between Agra's and SWNJ's samples.

Due to the discrepancies, additional samples were taken at Location 1 on November 2, 2016 by both Agra and SWNJ. The water quality results of these samples and the original samples for Location 1 are shown below in Table 3.

As shown in Table 3, the results from the additional samples between Agra and SWNJ are consistent, even for the parameters that experienced discrepancies during the original sampling round. Regarding the original discrepancies:

- The free and total chlorine measurements are consistent between Agra's and SWNJ's samples and the measurements are consistent with SWNJ's original sampling on October 4, 2016. It is therefore assumed that the high free chlorine reading at Location 1 from September 17, 2016 was likely a result of scouring of the test hydrant based on the recorded protocol and not reflective of the distribution system.
- The iron and manganese levels are consistent between Agra's and SWNJ's samples and the measurements are consistent with SWNJ's original sampling on October 4, 2016. It is therefore assumed that the high iron and manganese levels at all three locations from September 17, 2016 were likely a result of scouring of the test hydrant based on the recorded protocol and not reflective of the distribution system.
- The lead levels are consistent between Agra's and SWNJ's samples and the measurements are consistent with SWNJ's original sampling on October 4, 2016. It is therefore assumed that the very high lead level at Location 1 from September 17, 2016 was likely a result of scouring of the test hydrant based on the recorded protocol and not reflective of the distribution system.

Table 2 - Initial Baseline Water Quality Data

Sample	Sample No. 1		Sample No. 2		Sample No. 3	
Address	49 TAPPAN RD.		190/246 PALISADE AVE.		151 HOWARD TER.	
Town	HARRINGTON PARK		BOGOTA		LEONIA	
Location	HYDT #46-31		HYDT #25-18		HYDT #26-106	
Collector	Agra	Suez	Agra	Suez	Agra	Suez
Date Collected	9/17/2016	10/4/16 10:45	9/17/2016	10/4/16 11:40	9/17/2016	10/4/16 12:25
Date Received		10/4/16 14:27		10/4/16 14:30		10/4/16 14:32
pH	7.8	7.92	6.95	7.71	6.68	7
Temp, oC	25.7	19.8	26.8	21.7	26.9	23
Free Cl2, mg/L	2.04	<0.05	0.89	<0.05	0.09	<0.05
Total Cl2, mg/L	5.1	2.87	1.07	0.22	0.1	<0.05
Monochloramine, mg/L		2.78		0.13		<0.05
Turbidity, NTU		0.38		0.34		0.59
Alkalinity, mg/L	72	76	59	73	58	64
Chloride, mg/L	114	97	106	101	103	101
Hardness as CaCO3 mg/L		112		112		126
O-PO4, PO4 mg/L	<0.03	0.03	<0.03	<0.03	<0.03	0.06
T-PO4, PO4 mg/L	<0.2		<0.2		<0.2	
Conductivity, umhos/cm	540	545	514	535	487	552
TDS, mg/L	332	247	276	233	260	249
Calcium, mg/L	31.2	28	29	27	28.2	28
Ammonium, mg/L		0.27		0.03		ND
Ammonia, mg/L	0.92		0.50		<0.389	
Aluminum, mg/L		0.06		0.05		0.16
Iron, mg/L	0.222	0.01	0.73	0.06	1.60	0.28
Manganese, mg/L	<0.04	<0.01	0.14	<0.01	0.24	0.04
Copper, mg/L	<0.05	<0.01	<0.05	<0.01	<0.05	<0.01
Zinc, mg/L	<0.25	<0.01	<0.25	<0.01	<0.25	<0.01
Sodium, mg/L		52		50		51
Lead, ug/L	116	<0.66	<2	<0.66	<2	<0.66
Sulfate, mg/L	20.6		20.8		17.6	
LSI (pH - pHs)	-0.81	-0.76	-1.77	-0.99	-2.045	-1.23

Table 3 - Location 1 Water Quality Data

Sample	Sample No. 1A		Sample No. 1B		Sample No. 1C		Sample No. 1 (Original Sample)	
Address	49 TAPPAN RD.		49 TAPPAN RD.		49 TAPPAN RD.		49 TAPPAN RD.	
Town	HARRINGTON PARK		HARRINGTON PARK		HARRINGTON PARK		HARRINGTON PARK	
Location	HYDT #46-31		HYDT #46-31		HYDT #46-31		HYDT #46-31	
Agra Sample Information	Suez SOP for hydrant Sampling		Sample Tap-1 Hour Flush		e Tap-15 Minute Post Hydrant Cap		Initial Sampling	
Collector	Agra	Suez	Agra	Suez	Agra	Suez	Agra	Suez
Date Collected	11/2/16 14:17	11/2/16 14:10	11/2/16 15:31	11/2/16 15:25	11/2/16 15:56	11/2/16 15:55	9/17/2016	10/4/16 10:45
Date Received		11/2/16 16:35		11/2/16 16:35		11/2/16 16:35		10/4/16 14:27
pH (Lab)	7.88		8.06		8.01			
pH (Field)	8.06	7.98	8.07	8.20	8	8.29	7.8	7.92
Temp, oC (Lab)	17.1		15.2		17.9			
Temp, oC (Field)	18.5	14.2	17.5	14.6	17.5	14.3	25.7	19.8
Free Cl2, mg/L (Lab)	0.35		0.29		0.26			
Free Cl2, mg/L (Field)	0.31	<0.05	0.35	<0.05	0.31	<0.05	2.04	<0.05
Total Cl2, mg/L (Lab)	3.1		1.5		2.6			
Total Cl2, mg/L (Field)	3	2.83	2.7	2.72	2.8	2.71	5.1	2.87
Monochloramine, mg/L		2.65		2.40		2.41		2.78
Turbidity, NTU		0.23		0.26		0.28		0.38
Alkalinity, mg/L	73	80	75	78	74	77	72	76
Chloride, mg/L	88.9	99	89.6	101	91.1	99	114	97
Hardness as CaCO3 mg/L		131		126		115		112
O-PO4, PO4 mg/L	<0.250	<0.03	<0.250	<0.03	<0.250	<0.03	<0.03	0.03
T-PO4, PO4 mg/L		<0.03		<0.03		<0.03	<0.2	
Total Phosphorus as P mg/L	<0.100		<0.100		<0.100			
Conductivity, umhos/cm	509	246	508	509	507	515	540	545
TDS, mg/L	223	275	250	271	213	279	332	247
Calcium, mg/L	31.5	32	31.3	32	30	31	31.2	28
Ammonium, mg/L		0.34		0.38		0.34		0.27
Ammonia, mg/L	0.833	0.05	0.84	0.05	0.86	0.04	0.92	
Aluminum, mg/L		<0.01		<0.01		<0.01		0.06
Iron, mg/L	<0.2	<0.01	<0.2	<0.01	<0.2	<0.01	0.222	0.01
Manganese, mg/L	<0.04	<0.01	<0.04	0.01	<0.04	<0.01	<0.04	<0.01
Copper, mg/L	<0.05	<0.01	<0.05	<0.01	<0.05	<0.01	<0.05	<0.01
Zinc, mg/L	<0.25	51	<0.25	50	<0.25	49	<0.25	<0.01
Sodium, mg/L		<0.66		<0.66		<0.66		52
Lead, ug/L	<2	<0.66	<2	<0.66	<2	<0.66	116	<0.66
Sulfate, mg/L	15.4		15.9		15.2		20.6	
Magnesium, mg/L	7		7.12		7.28			
LSI (pH - pHs)	-0.58	-0.85	-0.65	-0.53	-0.7	-0.48	-0.83	-0.76

CDM Smith

Test Results

This section provides the test results for the study, which included both water quality testing of the water immersed with the coupons and visual inspection and loss of mass of the coupons. All laboratory work was performed by Agra.

Water Quality

Water quality readings for lead, copper, phosphate, pH and temperature were taken at the below intervals for all 36 test samples:

- 48 hours (2 days) after immersion of coupons
- 16 days after immersion of coupons
- 6 weeks (42 days) after immersion of coupons

The overall results are presented in Table 4. Table 4 shows the results of the water quality readings as well as the calculated corrosion rates for each of the coupon types.

Over the duration of the test period, lead continually leached into the water samples from the coupons. Figure 2 shows the lead concentrations for the 48 hour test (dark blue), 16 day test (green) and 6 week test (light blue) based on initial phosphate dose (both ZOP and PA).

Other than one stray data point showing a result over 12,000 ug/L of lead (red circle), the graph in Figure 2 shows a decrease in lead concentration after 6 weeks with samples containing phosphate in the water at a concentration of approximately 0.5 mg/L as PO_4 or greater compared with water samples containing phosphate concentrations less than 0.5 mg/L. However, there does not appear to be a significant difference after 6 weeks between water containing 0.5 mg/L as PO_4 of phosphate and water containing approximately 1.75 mg/L as PO_4 of phosphate as shown in the gray rectangle.

Table 4 - Overall Water Quality Results

Sample	Location	Chemical	Goal Dose (mg/L PO4)	Initial Goal pH	pH 48 hour	pH 2 weeks	pH 6 weeks	Temp (c) 48 hour	Temp (c) 2 weeks	Temp (c) 6 weeks	Measured PO4 (mg/L) 48 hour	Measured PO4 (mg/L) 2 weeks	Measured PO4 (mg/L) 6 weeks	Initial Lead (ug/L)	Lead (ug/L) 48 hour	Lead (ug/L) 2 weeks	Lead (ug/L) 6 weeks	Copper (ug/L) 48 hour	Copper (ug/L) 2 weeks	Corrosion Rate - Lead (mLs/year)	Corrosion Rate Copper (mLs/year)	Corrosion Rate - Mild Steel (mLs/year)
L1-0.5-1-Zn	1	ZOP	0.5	7.5	6.91	5.68	7.6	21.8	21.7	18.4	1.67	0.38	0.31	116.0	42.0	585	1296	0.12	0.16	1.4	0.6	6.3
L1-1.0-1-Zn	1	ZOP	1.0	7.5	7.27	6.28	7.72	21.9	21.1	18.4	1.03	0.30	0.31	116.0	99.5	122	1592	0.16	0.19	1.3	0.9	6.5
L1-1.5-1-Zn	1	ZOP	1.5	7.5	7.36	6.83	7.52	21.8	21.1	18.3	1.62	0.34	0.31	116.0	41.2	686	603	0.16	0.20	1.8	0.6	7.6
L1-2.0-1-Zn	1	ZOP	2.0	7.5	7.38	6.84	7.72	22.3	22.0	18.7	1.42	0.80	0.42	116.0	41.8	693	1455	0.09	0.27	1.8	0.6	7.2
L1-0.5-2-Zn	1	ZOP	0.5	System pH	7.44	6.79	7.43	21.6	21.9	18.4	0.70	0.23	0.36	116.0	39.7	297	1525	0.11	0.29	1.1	0.8	7.5
L1-1.0-2-Zn	1	ZOP	1.0	System pH	7.54	7.1	7.69	21.9	21.2	18.5	0.76	0.58	0.43	116.0	39.2	162	1698	0.12	0.13	1.3	0.7	5.9
L1-1.5-2-Zn	1	ZOP	1.5	System pH	7.58	7.17	7.63	21.7	21.0	18.5	1.39	0.53	0.36	116.0	43.1	162	2709	0.09	0.26	1.5	0.6	7.4
L1-2.0-2-Zn	1	ZOP	2.0	System pH	7.60	7.17	7.57	21.8	21.5	18.9	1.60	0.27	0.48	116.0	42.0	118	1885	0.08	0.16	1.3	0.6	7.6
L1-0-Zn	1	ZOP	0.0	System pH	7.59	7.11	7.8	22.0	22.4	19	0.22	0.05	0.31	116.0	40.0	472	3606	0.12	0.30	1.7	0.6	6.4
L1-0.5-1-O	1	PA	0.5	7.5	7.56	7.09	7.75	21.8	22.1	19.3	0.52	0.11	0.31	116.0	39.4	481	2476	0.11	0.31	1.7	0.4	6.6
L1-1.0-1-O	1	PA	1.0	7.5	7.53	7.14	7.54	21.9	21.3	18.9	0.39	0.28	0.32	116.0	41.3	341	2664	0.11	0.34	1.6	0.5	7.8
L1-1.5-1-O	1	PA	1.5	7.5	7.50	7.32	7.6	22.0	21.3	19	0.49	0.45	1.04	116.0	35.2	272	3199	0.07	0.27	1.3	0.5	6.8
L1-2.0-1-O	1	PA	2.0	7.5	7.49	7.21	7.64	21.9	21.5	19	0.74	0.60	0.78	116.0	39.4	422	4293	0.10	0.32	1.5	0.5	6.8
L1-0.5-2-O	1	PA	0.5	System pH	7.60	7.23	7.62	22.0	22.5	19.1	0.35	0.23	0.48	116.0	35.6	500	2344	0.09	0.40	1.1	0.6	6.9
L1-1.0-2-O	1	PA	1.0	System pH	7.62	7.23	7.65	22.0	21.6	19	0.61	0.41	0.51	116.0	38.8	562	2473	0.07	0.44	1.5	0.5	7.1
L1-1.5-2-O	1	PA	1.5	System pH	7.65	7.23	7.45	21.8	21.5	19.2	1.00	0.68	0.62	116.0	44.1	501	2027	0.08	0.48	1.5	0.6	7.7
L1-2.0-2-O	1	PA	2.0	System pH	7.64	7.17	7.59	21.9	21.5	19.1	1.35	0.91	0.47	116.0	38.1	449	1975	0.09	0.46	1.2	0.5	7.8
L1-0-O	1	PA	0.0	System pH	7.65	7.17	7.68	21.9	22.5	19	0.35	0.05	0.31	116.0	36.0	755	3765	0.13	0.42	1.6	0.5	6.3
L2-0.5-1-Zn	2	ZOP	0.5	7.5	7.40	7.03	7.75	21.9	22.6	19.1	0.56	0.62	0.51	2.0	49.2	520	1401	0.07	0.25	0.9	0.9	6.3
L2-1.0-1-Zn	2	ZOP	1.0	7.5	7.42	7.02	7.75	21.8	21.8	19.7	0.48	0.61	0.59	2.0	38.0	203	1329	0.06	0.98	1.3	0.7	6.7
L2-1.5-1-Zn	2	ZOP	1.5	7.5	7.28	7.2	7.76	21.8	21.9	19.5	1.45	0.94	0.49	2.0	40.5	316	1065	0.05	0.26	1.4	0.6	6.3
L2-2.0-1-Zn	2	ZOP	2.0	7.5	7.48	7.19	7.7	21.8	22.0	19.5	1.34	1.53	1.31	2.0	38.3	412	2432	0.05	0.35	1.5	0.7	7.0
L2-0.5-2-Zn	2	ZOP	0.5	System pH	7.39	7.14	7.57	22.0	23.1	19.5	0.52	0.85	0.56	2.0	46.8	924	2950	0.10	0.40	1.3	0.7	6.9
L2-1.0-2-Zn	2	ZOP	1.0	System pH	7.33	7.17	7.57	21.9	22.1	19.6	1.12	0.59	0.76	2.0	49.3	577	3047	0.10	0.44	1.7	0.7	6.3
L2-1.5-2-Zn	2	ZOP	1.5	System pH	7.39	7.17	7.6	21.8	21.9	19	1.16	0.98	1.00	2.0	46.3	598	3003	0.08	0.33	1.6	0.6	6.5
L2-2.0-2-Zn	2	ZOP	2.0	System pH	7.30	7.34	7.69	21.8	22.1	19.2	1.41	1.31	1.48	2.0	48.1	169	2198	0.08	0.29	1.0	0.9	7.2
L2-0-Zn	2	ZOP	0.0	System pH	7.31	7.24	7.56	21.7	23.1	19	0.32	0.18	0.31	2.0	1360	4217	6332	0.05	0.49	2.1	0.6	6.2
L3-0.5-1-Zn	3	ZOP	0.5	7.5	7.38	7.13	7.76	22.1	23.3	18.9	0.67	0.39	0.58	2.0	44.2	333	704.8	0.08	0.26	1.6	0.6	5.1
L3-1.0-1-Zn	3	ZOP	1.0	7.5	7.41	7.12	8.06	21.9	22.3	19	0.62	0.45	1.25	2.0	49.1	313	12780	0.09	0.25	2.6	0.6	7.6
L3-1.5-1-Zn	3	ZOP	1.5	7.5	7.42	7.34	8.01	21.9	22.3	19.2	1.07	1.24	1.09	2.0	40.6	395	2218	0.08	0.30	1.4	0.6	6.4
L3-2.0-1-Zn	3	ZOP	2.0	7.5	7.41	7.69	7.77	22.0	22.7	19.4	1.54	1.50	1.31	2.0	49.3	496	2987	0.09	0.22	1.7	0.6	7.6
L3-0.5-2-Zn	3	ZOP	0.5	System pH	7.41	7.48	7.7	21.9	24.5	19.8	0.41	0.84	0.65	2.0	42.1	643	2085	0.11	0.36	1.2	0.6	6.4
L3-1.0-2-Zn	3	ZOP	1.0	System pH	7.37	7.47	7.61	21.9	23.6	19.9	0.80	1.09	0.77	2.0	43.0	535	1839	0.09	0.28	1.3	0.6	6.8
L3-1.5-2-Zn	3	ZOP	1.5	System pH	7.37	7.52	7.75	21.9	23.1	19.8	1.08	1.03	1.03	2.0	40.8	408	1790	0.10	0.24	1.3	0.7	6.7
L3-2.0-2-Zn	3	ZOP	2.0	System pH	7.32	7.51	7.71	21.9	23.2	19.7	1.30	1.38	1.32	2.0	51.9	460	1967	0.10	0.24	1.4	0.5	6.7
L3-0-Zn	3	ZOP	0.0	System pH	7.31	7.44	7.61	21.9	23.7	19.8	0.32	0.41	0.34	2.0	56.5	828	3760	0.14	0.34	1.8	0.7	6.3

Figure 2 - Lead Concentrations Based on Initial Phosphate Dosages (as PO_4) Over Time

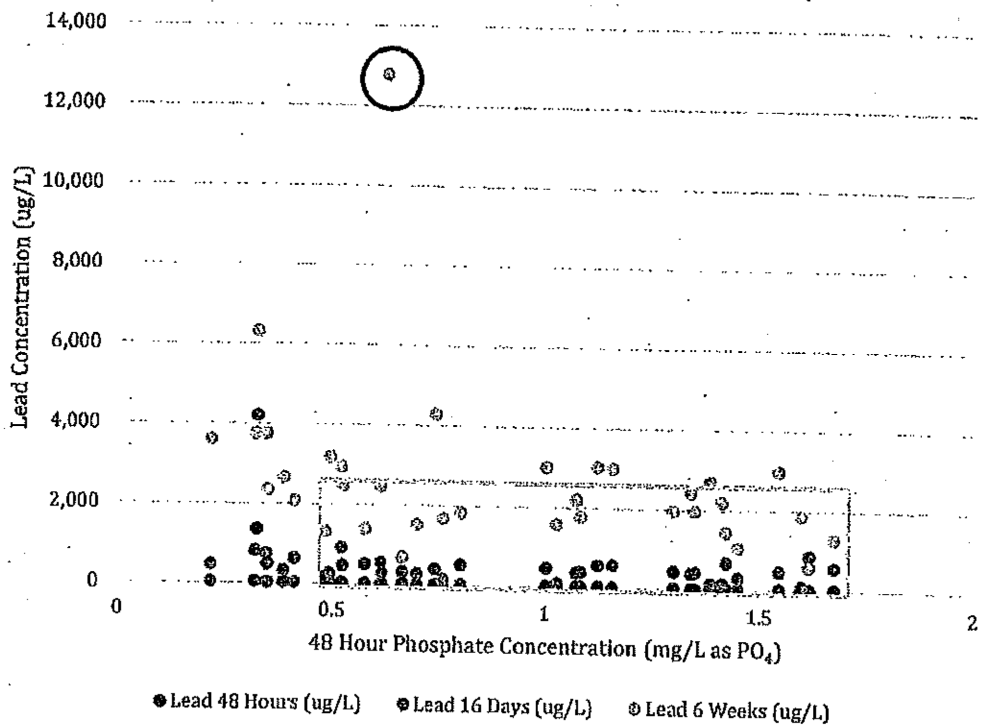
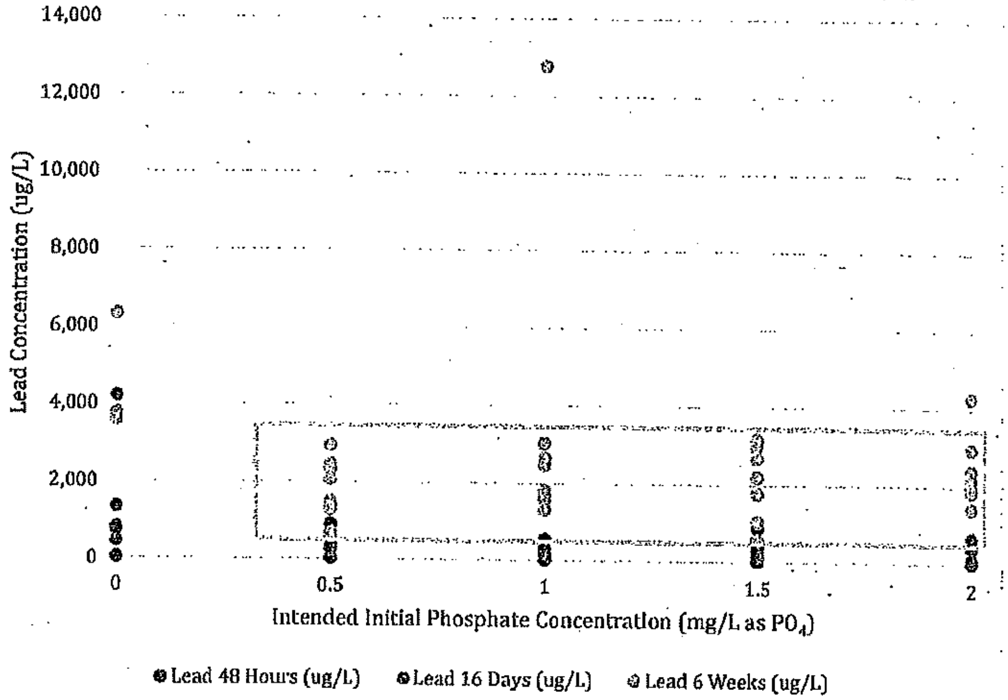


Figure 3 shows the lead concentrations over time based on the initial intended phosphate concentrations. Although the exact concentrations were not recorded, the general trend of increasing phosphate concentrations is assumed to be accurate.

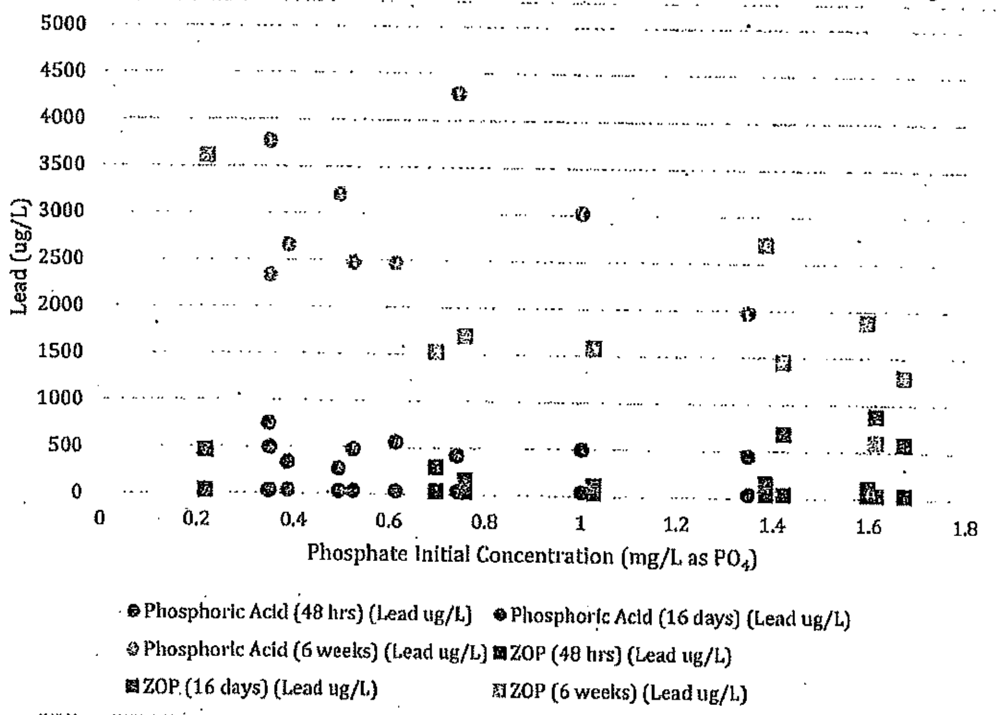
Figure 3 - Lead Concentrations Based on Intended Initial Phosphate Dosage (as PO_4) Over Time



Other than one stray data point, the graph in Figure 3 shows a decrease in lead concentration after 6 weeks (light blue) with samples dosed with phosphate at a concentration of approximately 0.5 mg/L as PO_4 or greater compared with water samples not dosed with phosphate. Again, there does not appear to be a significant difference after 6 weeks between water dosed with approximately 0.5 mg/L as PO_4 of phosphate and water dosed with approximately 2.0 mg/L as PO_4 of phosphate as shown in the gray rectangle.

Between the two inhibitor chemicals tested, samples that were dosed with ZOP experienced a lower amount of lead release than those with PA, as shown in Figure 4. Figure 4 plots the lead concentrations observed in the water samples at the three different intervals over the initial phosphate concentration. The circular markers represent the lead measurements in the water samples dosed with PA while the square markers are the lead measurements from the water samples dosed with ZOP. The difference between the two chemicals does not appear to be significant after 16 days of testing (green markers), however, the 6 week results (orange markers) showed that the samples dosed with ZOP exhibited lower levels of lead than the samples dosed with PA.

Figure 4 - Lead Concentrations for ZOP vs. PA at Location 1 Based on Initial Phosphate Dosages



Test Coupon Analysis

Lead, copper, and mild steel coupons were obtained for this test. The coupons were 3-inches by ½-inch with a single hole. The coupons were pre-weighed to 0.001 grams and shipped in individual corrosion resistant envelopes. After the 6 week sampling, the coupons were removed, photographed and returned to the supply company for final weighing. The weight measurements, as well as the density of coupon material and the duration of the test were used to calculate corrosion rates for each coupon sample in milliliters per year (mL/year). Density of 7.87 g/cm³ was used for mild steel, 8.89 g/cm³ for copper, and 11.35 g/cm³ for lead.

The level of corrosion based on the results is indicated as follows:

Non-corrosive <5 mL/year

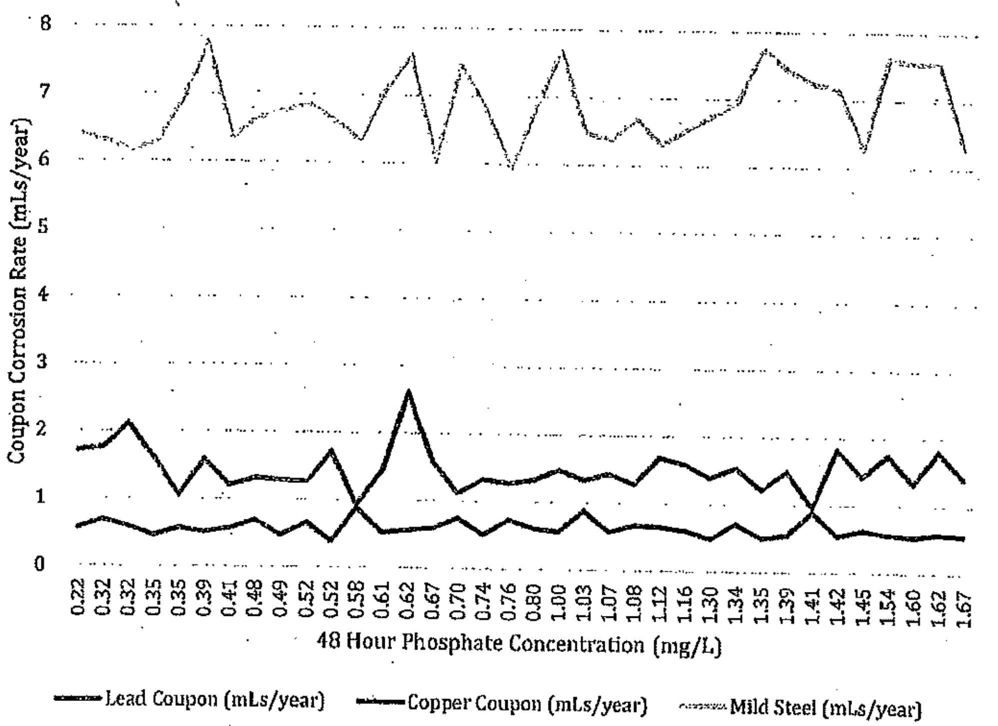
Acceptable 5-10 mL/year

Poor >10 mL/year

Figure 5 shows the corrosion rates for lead (green), copper (blue), and mild steel (grey) coupon materials based on initial phosphate concentrations (both ZOP and PA). The results indicate that corrosion rates were the highest for mild steel coupons, followed by lead coupons and

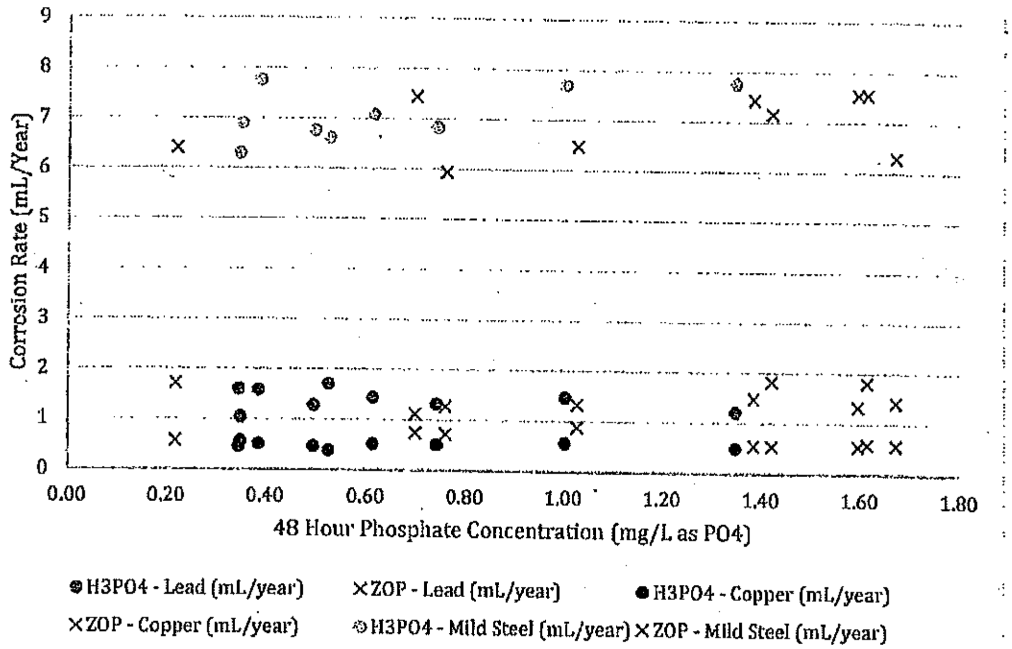
copper coupons, respectively. However, all corrosion rates were in the acceptable or non-corrosive ranges based on the above and corrosion of the coupons did not appear to decrease with increased levels of phosphate. Accordingly, coupon tests relying on weight of coupons to determine corrosion are typically set up for a longer duration. It is anticipated that additional corrosion would have been experienced if the test continued.

Figure 5 - Corrosion Rates Based on Initial Phosphate Dosage



Regarding performance of ZOP and PA with the coupon measurements for Location 1, no significant difference was seen in the results as shown in Figure 6. As anticipated, ZOP reduced corrosion on the mild steel over the PA due to the zinc addition. Over time, as the phosphate forms a protective coat on the metal, the difference in corrosion of mild steel between PA and ZOP is expected to increase with ZOP protecting the mild steel better than PA.

Figure 6 - Corrosion Rates - ZOP vs. Phosphoric Acid Based on Initial Phosphate Dosage



The coupon study has limitations for determining actual process modifications. It does not reflect actual conditions since the water is stagnant for a greater period than in a lead service line. pH and other water quality parameters will fluctuate over time with stagnant water due to processes such as nitrification. A fluctuating pH which will impact the performance of the corrosion inhibitor. The intent of this study was limited to determining if there were any significant benefits of ZOP versus PA and if a dosage range could be identified.

Conclusions and Recommendations

This study evaluated the impacts of adding a corrosion inhibitor (ZOP and PA) to the finished water at three (3) different locations in the distribution system of the Haworth WTP with the goal of reducing corrosion in the distribution system. Prior to any modifications made to the treatment process, the New Jersey Department of Environmental Protection (NJDEP) shall review the study results and be provided an opportunity to comment. The NJDEP has approved the concept of adding a phosphate-based corrosion inhibitor to the Haworth system pending the results of this study.

The results showed that adding a phosphate corrosion inhibitor to the finished water does reduce the lead leaching into the drinking water by coating the immersed lead coupons. As expected, the benefits of the added phosphate were shown to increase over time as the samples with phosphate showed lower lead levels compared with samples without phosphate after 6 weeks. The 16 day samples did not show a measurable improvement from the phosphate between the samples with and without added phosphate. This can be seen in Figures 2 and 3 above.

Chemical Recommendation

As shown in Figure 4, as the test progressed, the ZOP reduced lead levels to a greater extent than the PA with reduced corrosion on the lead coupon. Corrosion on the mild steel coupon (representing unlined cast iron pipe) was significant for all samples as expected, however, a benefit of one chemical over the other was not seen in the six-week test. The copper coupon showed a greater benefit from the PA than the ZOP. Based on the makeup of the distribution system for the Haworth WTP, ZOP is recommended over PA based on the greater reduction in lead experienced and its anticipated improved performance on unlined cast iron.

Dosage Recommendation

Although the data shows a clear benefit from adding phosphate, the higher dosages (1.5-2.0 mg/L as PO_4) did not show significant improvement over the lower dosages (0.5-1.0 mg/L as PO_4) as shown in Figures 2, 3 and 4. As a result, it is recommended that a dose of 0.5 mg/L as PO_4 of phosphate be initially added to the drinking water at the Haworth WTP. Based on the results of the next round of lead sampling, the dosage may be increased to 1.0 mg/L as PO_4. At this time, the data does not show a benefit of increasing the dosage above 1.0 mg/L as PO_4.

The Environmental Protection Agency's (EPA's) Optimal Corrosion Control Treatment Evaluation Technical Recommendations for Primary Agencies and Public Water Systems (OCCT), dated March 2016, recommends an orthophosphate dose of 1.0 to 3.0 mg/L as PO_4 when pH is in the range of 7.2 to 7.8 which generally corresponds with Haworth's distribution system pH. However, the OCCT recommends doses as high as 3.0 mg/L as PO_4 or higher to control lead release from lead service lines, to control copper corrosion and/or if a system has aluminum, iron, manganese or magnesium in the water.

The OCCT also recommends two approaches for implementation. It recommends either gradually increasing phosphate dosages or starting with a higher passivation dose and then, after a certain period, switching over to a lower maintenance dose for long-term corrosion control. Because the results showed a reduction in lead at lower doses of 0.5 to 1.0 mg/L as PO_4, it is recommended that SWNJ begin at a lower dose of PO_4 and increasing over time if needed.

Other System Modification Recommendation

The initial pH and final pH generally ranged from 7.3 to 7.8 which is within the EPA recommended pH range of 7.2 to 7.8 for corrosion control. However, the samples taken in November at Location 1 showed pH consistently over 8.0. The OCCT recommends avoiding operating between pH of 8 and 8.5 based on laboratory results showing less effective control of lead release occurring in this pH range. The addition of the ZOP may decrease the pH slightly. Therefore, SWNJ should continue to raise the pH with caustic to maintain the existing point-of-entry pH. This can be reevaluated once the ZOP has lined the piping and lead sampling shows a reduction in lead levels.

Prior to full-scale implementation, SWNJ will contact the Bergen County Utilities Authority (BCUA) to notify them of the orthophosphate addition. BCUA is not believed to have a phosphate discharge limit.

Full-scale Distribution System Water Quality Monitoring Recommendations

In preparation for the process change, NJDEP has requested the following be completed in the Permit to Construct dated December 21, 2016:

- SWNJ to submit a revised Water Quality Parameter Sampling Plan.
- SWNJ will sample alkalinity and temperature at the point of entry as requested.
- SWNJ will notify the NJDEP at least one week prior to utilizing the new treatment.

It is also recommended that SWNJ sample at least once per month for the first year to monitor the performance of the new chemical at one location near the plant and at several locations in the far reaches of the distribution system including adjacent to any active interconnections. This can be accomplished either with lead service household taps or with a new sample tap or a loop system with harvested lead pipe installed on analyzer discharge pipes in pump stations throughout the system. The stations will be selected to capture the variable water quality conditions (i.e. pH, chlorine residual, water age, etc.) throughout SWNJ's system. The sample points will be used to monitor the progress of the ZOP coating on the lead pipe. The testing will be completed in accordance with AWWA and EPA guidelines and recommendations.

cc:
Steve Pudney, Diane Zalaskus, Xenia Feliz, NJDEP
Peter Fitzpatrick, Steve Wondrack, Lynn Marie DeCarlo, Sheng-Lu Soong, Tom Neilan, Emad Sidhom, SWNJ
Steve Medlar, Ning Tong, John Rogers, Keith Kelly, Ji Im, CDM Smith
file

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February 5, 2019

New Jersey Department of Environmental Protection
Mail Code 40 I-04Q
Division of Water Supply & Geoscience Water System Operations Element
Bureau of Safe Drinking Water
401 E. State Street- P.O. Box 420
Trenton, New Jersey 08625-0420

RE: Corrosion Control Treatment Summary and Evaluation - Lead Action Level Exceeded
Suez Water New Jersey Hackensack PWSID: NJ0238001
EA ID #: PEA190001 - 0238001

Dear Felicia Fieo,

This document serves as a summary of the evaluation and corrective measures taken to optimize the existing treatment as requested by NJDEP in its letter dated January 7, 2019 (EA ID #: PEA190001 – 0238001). Also enclosed for your review is the BWSE40 and a comprehensive review by Mott MacDonald.

BACKGROUND:

SUEZ Water New Jersey Hackensack, NJ0238001, proactively adopted and began implementing a zinc orthophosphate corrosion control strategy in 2017. SUEZ Water retained CDM Smith to develop this strategy. Key milestones in implementing the strategy included:

1) 10/16/2017: In October, the system was placed in service at 0.5ppm PO_4. The goal was to gradually introduce Zinc Orthophosphate into the system while maintaining the pH adjustment until the inhibitor formed a layer on the pipe wall, and then 2-3 months later increase dosage to 1.0ppm.
2) 01/17/2018: In January, the zinc orthophosphate dosage was increased to 1.0ppm.
3) Approximately 05/2018: In May, the pH reduction started at a very slow rate. The entire time the Langelier Index was monitored and remained within the NJDEP requirement of 1.0 to -1.0. pH was adjusted from 8.00 to 7.60 at the Haworth Treatment Plant over a ~6 month period.

EVALUATION:

In light of the recent Action Level Exceedance, SUEZ Water NJ immediately conducted a thorough review that consisted of the following:

- A review of the distribution system disturbances,
- A review of all relevant lead and copper data,

suez

- A review of the profile data from a homeowner served by a lead service line,
- Site visits to the homes that exceeded the action level to ensure proper sample collection was conducted,
- The CCT strategy and related analytical results were reviewed by SUEZ, CDM Smith, and Mott MacDonald (see attached), and
- pH analytical procedures were audited and enhanced.

CORRECTIVE MEASURES:

SUEZ, CDM Smith (see attached email correspondence), and Mott MacDonald all agree that changing corrosion inhibitor dosage and/or pH adjustment at this time is premature. Increased monitoring is required first before any such changes are pursued.

The increased monitoring recommended by Mott MacDonald include:

- Increased monitoring at Revised Total Coliform Rule (RTCR) Sites.
- Increased monitoring at Haworth Treatment Plant Point of Entry.
- Lead and Copper Loop testing in distribution system.
- Continued Lead profile data.
- Scale analysis of harvested pipe.

By way of this evaluation, and as suggested by Mott MacDonald in the attached evaluation, we are requesting an extension of the submission for optimal CCT recommendation as detailed in Item #5 in EA ID #: PEA190001 – 0238001 to October 31, 2019.

The approach will be to look at the distribution system as a whole with the help of Mott MacDonald and Abigail Cantor from Process Research Solutions, LLC, an engineering consulting firm who specializes in water quality investigations for municipal drinking water systems, and propose optimal CCT recommendations at that time.

Sincerely,

Peter Fitzpatrick
Chief Operator

Thomas Neilan
Director of Operations

BWSE-40
3/2018

Office Use Only
Reviewed by:
Date:

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
Division of Water Supply and Geoscience
Bureau of Water System Engineering
Water System Assistance Section
Mail Code 401-04Q – P.O. Box 420
Trenton, New Jersey 08625-0420
Tel# 609-292-2957- Fax # 609-633-1495
watersupply@dep.nj.gov

REMEDIAL MEASURES REPORT FORM

Submit this report detailing proposed and/or completed remedial measures to the Bureau of Water System Engineering within thirty (30) calendar days of receipt of your Notice of Non-Compliance via mail, fax, or email. Pursuant to the State Primary Drinking Water Regulations at N.J.A..C 7:10-5.7(a), you are required to take any action necessary to achieve compliance within one year of the violation. Note: the one year includes the collection of samples demonstrating compliance with the Maximum Contaminant Level/Treatment Technique/Action Level. This remedial measures report form must be completed, reviewed, and signed by the owner/executive director and if applicable the licensed operator of record.

1. General Information

PWSID#: NJ0238001	PWS Name: SWNJ-Hackensack	
PWS Contact Name: Lynn Marie DeCarlo	PWS Contact Email: <lynnmarie.decarlo@suez.com>	PWS Contact Phone#: (201) 599-6020

Violation/Trigger: ☐ MCL Violation ☐ Treatment Technique Violation ☑ Action Level Exceedance

Contaminant: Lead

Violation Date: 1-3-2019 Notice of Noncompliance Received Date: 1-8-2019

Is treatment currently installed to address the contaminant of concern? ☑ Yes ☐ No

2. Remedial Measures (Proposed and/or Completed)

Select all applicable remedial measures and provide a brief explanation for the selection(s) below. A timeline of the milestones necessary to complete the selected remedial measure(s) must be outlined in Section 3.

a. Maintain/Repair existing treatment	☑
b. Install treatment / Modify current treatment	☐
c. Permanently remove the contaminated source from service	☐
d. Use an alternate source(s) of water supply	☐

Explanation: SUEZ plans to maintain the current corrosion control strategy. See attached for detail.

3. Milestones:

Describe what actions will be or have been taken. A timeline of milestones to complete the proposed remedial measure(s) must be outlined. If a remedial measure(s) is completed, describe what action was taken and provide supporting documentation. Where applicable, milestones should include: invoices, estimates, receipts, submittal of permit application, consultation with manufacturer, construction and installation of treatment and sampling. The milestone timeframes need to take into consideration that a system is required to bring the water into compliance within one year of the violation (i.e. including sample collection of sufficient compliance data).

Milestone 1:	Description: EVALUATION: • A review of the distribution system disturbances, • A review of the historical lead and copper data, • A review of the profile data from a homeowner served by a lead service line, • Site visits to the homes that exceeded the action level to ensure proper sample collection was conducted, • The CCT strategy and related analytical results were reviewed by SUEZ, CDM Smith, and Mott MacDonald, • pH analytical procedures were audited and procedures were strengthened.
	Proposed Completion/Completed Date: Completed 1/30/2019
Milestone 2:	Description: ADDITIONAL TESTING: • Increased monitoring at Revised Total Coliform Rule (RTCR) Sites, • Increased monitoring at Haworth Treatment Plant Point of Entry, • Lead and Copper Loop in distribution system, • Continued Lead profile data, • Scale analysis of harvested pipe.
	Proposed Completion/Completed Date: Proposed Completion: 12/31/2019
Milestone 3:	Description: Propose optimal corrosion control strategy to NJDEP with the help of Mott MacDonald. Requested extension for completion date is 10/31/2019 to allow SUEZ to have time to deploy additional monitoring equipment (ie. test loops) and process summer month data.
	Proposed Completion/Completed Date: Proposed Completion: 10/31/2019
Milestone 4:	Description:
	Proposed Completion/Completed Date:

4. Certification

This remedial measures report form must be completed, reviewed, and signed by the owner/executive director and if applicable the licensed operator of record.

PWSID# NJ0238001	PWS Name: SWNJ-Hackensack
Completed by (print name): Andrea McElroy	
Original Signature:	Date: 02/05/2019
Water System Owner/Executive Director (print name): Mark Mckoy	
Original Signature	Date: 02/05/2019
Licensed Operator and License Number (print name): Thomas Neilan (0006880) and Peter Fitzpatrick (488942)	
Original Signature	Date: 02/05/2019

Mcelroy, Andrea

From: Kutzing, Sandra <KutzingSL@cdmsmith.com>
Sent: Friday, January 11, 2019 8:20 AM
To: Mcelroy, Andrea; Rego, Carol; Neilan, Thomas
Cc: Assante, Michael; Walczyk, Carol; Kelly, Keith
Subject: RE: More data and maps

Hi Andrea,

Yes based on our discussions and everything we've seen, including the profile data, we recommend holding at around the 7.6 pH and not raising it at this point back to the 7.8. System may have gone through some sort of transition due to the lowering of the pH. However, based on December results, it appears to be stabilizing at this point.

Can you send around the January lead profile results when you have them to confirm this trend? Do you plan to do total and dissolved lead again?

Thanks,
Sandy

From: Mcelroy, Andrea <andrea.mcelroy@suez.com>
Sent: Tuesday, January 8, 2019 2:29 PM
To: Rego, Carol <RegoCA@cdmsmith.com>; Neilan, Thomas <thomas.neilan@suez.com>
Cc: Kutzing, Sandra <KutzingSL@cdmsmith.com>; Assante, Michael <michael.assante@suez.com>; Walczyk, Carol <carol.walczyk@suez.com>; Kelly, Keith <KellyKF@cdmsmith.com>
Subject: RE: More data and maps

Hello All,

I did send the sampling instructions and attached are the most recent sampling profile with total and dissolved lead levels. Was there anything else that you wanted us to send over for review?

Are we all in agreement that we should continue with our current pH and orthophosphate dosage strategy?

Thank you for your help,
Andrea

From: Mcelroy, Andrea
Sent: Thursday, January 3, 2019 4:52 PM
To: 'Rego, Carol' <RegoCA@cdmsmith.com>; Neilan, Thomas <thomas.neilan@suez.com>
Cc: Kutzing, Sandra <KutzingSL@cdmsmith.com>; Assante, Michael <michael.assante@suez.com>; Walczyk, Carol <carol.walczyk@suez.com>; Kelly, Keith <KellyKF@cdmsmith.com>
Subject: RE: More data and maps

Sampling instructions did not change, please see attached.

Thanks,
Andrea

From: Rego, Carol <RegoCA@cdmsmith.com>
Sent: Thursday, January 3, 2019 4:24 PM
To: Neilan, Thomas <thomas.neilan@suez.com>
Cc: Kutzing, Sandra <KutzingSL@cdmsmith.com>; Mcelroy, Andrea <andrea.mcelroy@suez.com>; Assante, Michael <michael.assante@suez.com>; Walczyk, Carol <carol.walczyk@suez.com>; Kelly, Keith <KellyKF@cdmsmith.com>
Subject: Re: More data and maps

Tom, completely agree... no changes until we talk collectively and get a little more info/data... it's possible that the system has already (or is in the process of) acclimating to the change and if so, we don't want to interrupt that ....

On Jan 3, 2019, at 4:18 PM, Neilan, Thomas <thomas.neilan@suez.com> wrote:

Sandy
Thanks for the response. Our pH was gradually adjusted based on the EPA OCCT manual and the DEP letter from 8.1 to the current target of 7.6. This adjustment was made after there was noted improvement in the first half of 2018. This pretty much follows the recommendations from CDM's Corrosion Control Study (not sure where 7.8 was recommended; email perhaps?). This is for POE. Isn't that where the target pH is? Should we be targeting higher to compensate for the variability in the large distribution network? As you recommend, we probably shouldn't be adjusting for anything now to further disrupt the water chemistry. We'll get back to you regarding the conference call for next week.
Thanks again.

From: Kutzing, Sandra <KutzingSL@cdmsmith.com>
Sent: Thursday, January 3, 2019 3:04 PM
To: Neilan, Thomas <thomas.neilan@suez.com>; Mcelroy, Andrea <andrea.mcelroy@suez.com>; Assante, Michael <michael.assante@suez.com>; Walczyk, Carol <carol.walczyk@suez.com>
Cc: Rego, Carol <RegoCA@cdmsmith.com>; Kelly, Keith <KellyKF@cdmsmith.com>
Subject: RE: More data and maps

Tom, Andrea, Carol, Michael,

Based on the analysis we've done so far on the data you sent over, it appears that the orthophosphate was starting to improve conditions in the system in the first half of 2018. Then in the second half of 2018, something happened which increased lead levels. Two potential hypotheses to consider:

- pH Change – potentially too great of a change from 7.9 to 7.4 in 5 months
- Sampling – potential sampling issues with new sampling sites (10 out of 14 that exceeded the LAL are new sites)

pH Change
The recommendation in the CDM Smith report was to reduce pH from 8.1 to 7.8, however, DEP and the OCCT manual recommend a pH of 7.2 to 7.8 which is why I believe the pH was reduced further. The pH was reduced to below 7.4 in October 2018 and then back up to 7.5-7.6 in Nov/Dec (see graph below for 2018 average pH values). It's possible the pH was a little too variable for a stable orthophosphate scale. It may be premature, however, to recommend raising the pH back up to around 7.8. Instead, we recommend taking another sequential sampling as soon as possible. There is a possibility that the sampling happened to catch the "adjustment period" while the system was acclimating to a new pH condition. We noticed that the lead results in the last sequential sampling started to come down again so it's possible they've continued in that direction. We recommend stabilizing the pH as much as possible until the sequential sampling results are available. For the sequential sampling, please consider sampling for dissolved and particulate which will provide more information on what is going on.

Andrea, would you mind sending the latest graph with all of the sequential sampling events?

Michael, can you do a map similar to the "hot spots" for lead that you did with pH values (as the "hot spots" and also show the lead results as points on the map (in ranges by color)?

<image003.png>

Sampling
Because 10 of the 14 sites that exceeded the LAL in the second half of 2018 were brand new sites, we're curious if the instructions have changed for sampling (i.e. stagnation period, flushing protocol, aerators, etc.). Can you provide the instructions that were provided to the customers for this last sampling round? Did the instructions change from previous sampling rounds? If so, what were the changes?

We believe one (or both) of these factors contributed to the increased lead levels in the second half of 2018. The data requested will help us further refine our analysis and recommendations. Carol and I can be available for a conference call tomorrow or next week to discuss. Let us know what works best for you.

Thank you,
Sandy

Sandra L. Kutzing, PE | Project Manager | CDM Smith | 110 Fieldcrest Ave, #8, 6th Floor, Edison, NJ 08837 | O 732-590-4741 | M 917-805-2554 | kutzingsl@cdmsmith.com | www.cdmsmith.com

From: Neilan, Thomas <thomas.neilan@suez.com>
Sent: Friday, December 28, 2018 12:40 PM
To: Kutzing, Sandra <KutzingSL@cdmsmith.com>; Mcelroy, Andrea <andrea.mcelroy@suez.com>
Cc: Assante, Michael <michael.assante@suez.com>; Walczyk, Carol <carol.walczyk@suez.com>; Rego, Carol <RegoCA@cdmsmith.com>
Subject: RE: More data and maps

Sandy and Carol R
Happy Holidays! When can we expect to get some feedback? Thank you

From: Kutzing, Sandra <KutzingSL@cdmsmith.com>
Sent: Friday, December 21, 2018 2:43 PM
To: Mcelroy, Andrea <andrea.mcelroy@suez.com>
Cc: Neilan, Thomas <thomas.neilan@suez.com>; Assante, Michael <michael.assante@suez.com>; Walczyk, Carol <carol.walczyk@suez.com>; Rego, Carol <RegoCA@cdmsmith.com>
Subject: RE: More data and maps

Thank you Andrea for sending. We will include and let you know if there are other parameters that would be helpful in the analysis.

Sandy

From: Mcelroy, Andrea <andrea.mcelroy@suez.com>
Sent: Thursday, December 20, 2018 10:27 PM
To: Kutzing, Sandra <KutzingSL@cdmsmith.com>
Cc: Neilan, Thomas <thomas.neilan@suez.com>; Assante, Michael <michael.assante@suez.com>; Walczyk, Carol <carol.walczyk@suez.com>
Subject: More data and maps

Sandy,

I have included more maps that the GIS team put together to help us further evaluate. I have also gathered more data on pH and O-PO4 in the system. The O-PO4 is amazingly stable. pH is not very stable, particularly in the area of the hot spot. Below is HD90 East Rutherford, you can better see the location in the ROUTINE RTCR Monitoring Map. If you are looking for any additional parameters, please let me know, we have so much data. I have also added the recent Haworth Treatment Plant pH to the Follow up WQP 2018 data.

Can you add this to your evaluation with Carol Rego? We appreciate your help!

Andrea

<image004.jpg>

Andrea McElroy
Chief Chemist
New Jersey Operations

SUEZ
400 Lake Shore Drive
Haworth, NJ 07641
Laboratory: 201-599-6039
<image005.jpg>
Please think twice before printing this email.

Before printing a copy of this email, please consider the environment. This email and any attachments are confidential and intended for the named recipient or entity to which it is addressed only. If you are not the intended recipient, you are hereby notified that any review, re transmission, or conversion to hard copy, copying, circulation or other use of this message and any attachments is strictly prohibited. Whilst all efforts are made to safeguard their content, emails are not secure and SUEZ cannot guarantee that attachments are virus free or compatible with your systems and does not accept liability in respect of viruses or computer problems experienced. SUEZ reserves the right to monitor all email communications through its internal and external networks

State of New Jersey

PHILIP D. MURPHY
GOVERNOR

SHEILA Y. OLIVER
LT. GOVERNOR

DEPARTMENT OF ENVIRONMENTAL PROTECTION
Mail Code 401-04Q
Division of Water Supply & Geoscience
Water System Operations Element
Bureau of Safe Drinking Water
401 E. State Street - P.O. Box 420
Trenton, New Jersey 08625-0420
Tel #: (609) 292-5550 - Fax #: (609) 633-1495
https://www.nj.gov/dep/watersupply/

CATHERINE R. MCCABE
COMMISSIONER

January 7, 2019

CERTIFIED MAIL/RRR
7018 0680 0000 8443 3198

Lynn Marie DeCarlo
Suez Water New Jersey Hackensack
200 Lake Shore Drive
Haworth, NJ 07641

RE: Notice of Non-Compliance – Lead Action Level Exceeded
Suez Water New Jersey Hackensack
PWSID: NJ0238001
EA ID #: PEA190001 - 0238001

Dear Ms. DeCarlo:

Enclosed for service upon you is a Notice of Non-Compliance issued by the Department.

Please submit your response to this Notice of Non-Compliance to the Bureau of Water System Engineering (BWSE) at the letterhead address indicated above. If you need further assistance contact Leronda Aviles at (609) 292-2957 or Leronda.Aviles@dep.nj.gov. When contacting the BWSE, reference PWSID NJ0238001 and EA ID #: PEA190001 so that we can assist you more efficiently.

Sincerely,

for Joseph [signature]
Felicia Fieo, Section Chief
Bureau of Safe Drinking Water

Enclosure
cc: Northern Bureau of Water Compliance and Enforcement (via email)
BWSE, Lead Team
Joe Mattle, BWSE
Peter P. Fitzpatrick, T-4 Licensed Operator
Thomas M. Neilan, W-4 Licensed Operator

State of New Jersey

PHILIP D. MURPHY
GOVERNOR

SHEILA Y. OLIVER
LT. GOVERNOR

DEPARTMENT OF ENVIRONMENTAL PROTECTION
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https://www.nj.gov/dep/watersupply/

CATHERINE R. MCCABE
COMMISSIONER

NOTICE OF NON-COMPLIANCE

EA ID #: PEA190001 - 0238001

Name: Suez Water New Jersey Hackensack
Location: 200 Lake Shore Drive
Haworth, NJ 07641
Identifying #: PWSID NJ0238001

You are hereby NOTIFIED that a review of our records conducted on January 03, 2019, found that your facility was out of compliance with the regulations promulgated pursuant to the New Jersey Safe Drinking Water Act, NJSA 58: 12A-1 et seq. This NOTICE OF NON-COMPLIANCE has been recorded as part of the permanent enforcement history of Suez Water New Jersey Hackensack at the above location because your water system failed to comply with the following requirement:

Requirement: Comply with the Action Level (AL) for lead set forth in [40 CFR 141.80(c)(1)]

Violation Details: The lead action level was exceeded during the monitoring period 07/01/2018 to 12/31/2018 for the following sample point ID: Distribution System. The 90th percentile value for one hundred eight (108) samples collected 07/16/2018 to 12/12/2018 was 18 micrograms per liter (μg/L) which exceeded the action level of 15 μg/L.

In response to this NOTICE OF NON-COMPLIANCE, the following corrective actions must be undertaken to achieve compliance:

1. **Your system must continue to follow the standard monitoring requirements for frequency and number of samples for lead and copper pursuant to 40 CFR 141.86 et seq.** Based on your current residential population of 792,713 persons, a minimum of one hundred (100) samples must continue to be collected for at least two consecutive six-month periods beginning during 1st half 2019.

2. Conduct source water monitoring for lead and copper from each entry point to the distribution system, including any permanent active interconnection, in accordance with 40 CFR 141.88 et seq. A source water treatment recommendation (based on the results) must also be provided, in accordance with 40 CFR 141.83(a)&(b), to the BWSE. Please note that the source water treatment recommendation is required even if it is determined that your source is not contributing to the elevated levels of lead in your water system. Both your source water monitoring and your source

water treatment recommendation are due within six (6) months after the end of the monitoring period in which the lead action level was exceeded. **The source water monitoring and treatment recommendation is due on or before 06/30/2019.**

3. Although you were previously notified by the BWSE, in a letter dated 12/04/2018, to begin optimal water quality parameter (WQP) monitoring on January 1, 2019, Suez Water New Jersey Hackensack must continue to conduct follow-up WQP monitoring as a result of the lead AL exceedance demonstrating the existing corrosion control treatment (CCT) is not optimized.

   WQP monitoring schedule is available on New Jersey's Drinking Water Watch at https://www.nj.gov/dep/watersupply/waterwatch. Additional details regarding WQP monitoring requirements can be found at 40 CFR 141.87 et seq.

   Monitoring results must be submitted electronically to the Bureau of Safe Drinking Water (BSDW) by the 10th day following the end of the month in which the sample was collected. Please note that if the WQP analyses are conducted by a person acceptable to the State, the WQP analytical results shall be entered onto the Excel Generic WQP Analysis Spreadsheet and emailed as an attachment to watersupply@dep.nj.gov with "Month or Quarter/Year WQP Results for PWSID Submittal for PWSID#NJ0238001" in the subject line. The Excel Generic WQP Analysis Spreadsheet and instructions are located at https://www.state.nj.us/dep/watersupply/dws-sampreg.html.

4. BSDW records indicate that your system uses zinc orthophosphate corrosion inhibitor and sodium hydroxide for pH adjustment for CCT. The recently exceeded AL for lead indicates that the CCT is not optimized. Suez Water New Jersey Hackensack shall evaluate the performance of the CCT and the most recent WQP data to determine appropriate immediate corrective measures to optimize the treatment. **Submit a summary of the evaluation and corrective measures taken to optimize the existing treatment to the BWSE within 30 days from the date of this letter. The submittal shall be reviewed, approved and signed by the licensed operator of record.**

   Please be advised that the BWSE may require additional WQP monitoring based upon the review of your corrective action summary.

5. On May 2, 2017, BWSE conditionally approved Suez Water New Jersey - Hackensack's CCT recommendation. **However, due to the lead AL exceedance, a new optimal CCT recommendation prepared in accordance with 40 CFR 141.82(a) et seq., must be submitted to the BWSE as soon as possible but no later than six (6) months after the end of the monitoring period during which the lead AL was exceeded, in accordance with 40 CFR 141.81(e) et seq.**

   The water system should use EPA's Optimal Corrosion Control Treatment (OCCT) Evaluation Technical Recommendations for Primacy Agencies and Public Water Systems when evaluating CCT options. The CCT recommendation must be accompanied by the appropriate OCCT Evaluation Template for your system's population. The OCCT Evaluation Recommendations and Templates are available at: https://www.epa.gov/dwreginfo/optimal-corrosion-control-treatment-evaluation-technical-recommendations.

   The CCT recommendation and supporting documentation is due on or before 06/30/2019 and shall be reviewed, approved and signed by the licensed operator of record.

6. Public education should be completed immediately; however, no later than 60 days following the monitoring period in which the lead AL was exceeded in accordance with 40 CFR 141.85(b)(4). **Public education must be completed on or before 03/01/2019.** Please note that all public education materials must be reviewed and approved by the BWSE prior to issuing.

   Public education information and templates are available at https://www.nj.gov/dep/watersupply/dws-sampreg.html. Public education information shall be delivered as follows:

   i. Deliver printed educational materials to all bill paying customers;
   ii. Deliver educational material to local public health agencies even if they are not located with the water system's service area;
   iii. Contact the local public health agencies directly by phone or in person;
   iv. Deliver printed education material and an informational notice encouraging distribution to the following facilities located within the water system's service area:
      a. Public and private schools or school boards
      b. Women, Infants, and Children and Head Start Programs
      c. Public and private hospitals and medical clinics,
      d. Pediatricians
      e. Family planning clinics
      f. Local welfare agencies
      g. Licensed childcare centers
      h. Public and private preschools
      i. Obstetricians-Gynecologists and Midwives
   v. Provide required message on or in each water bill (no less often than quarterly);
   vi. Post educational material on the water system's website if the system serves a population greater than 100,000;
   vii. Submit a press release to newspaper, television, and radio stations;
   viii. Implement at least three of the following activities:
      a. Public service announcements
      b. Public meetings
      c. Paid advertisements
      d. Household deliveries
      e. Public area information displays
      f. Targeted individual customer contact
      g. Emails to customers
      h. Direct material distribution to all multi-family homes and institutions

7. Submit a completed Public Education Certification Form to the BWSE that demonstrates that public education materials met the content requirements in 40 CFR 141.85(a) and the delivery requirements in 40 CFR 141.85(b) and were provided to the persons served by your water system in accordance with 40 CFR 141.90(f). **The Public Education Certification form is available at** https://www.nj.gov/dep/watersupply/pdf/bsdw55.pdf **and due by 03/11/2019.**

8. Provide a lead consumer notice to the persons served by your water system of the individual tap results from lead tap water monitoring in accordance with 40 CFR 141.85(d). **This notice is**

required within 30 days of when the water system learns of the results and must address the following:

i. The results of lead tap water monitoring for the tap that was tested;
ii. An explanation of the health effects of lead;
iii. The steps consumers can take to reduce exposure to lead in drinking water;
iv. Contact information for the water system; and
v. The notice must also provide the maximum contaminant level goal and the action level for lead and the definitions for these two terms from 40 CFR 141.153(c).

Lead Consumer Notice templates are available at https://www.nj.gov/dep/watersupply/dws-sampreg.html.

9. **Submit a completed Consumer Notice of Lead Tap Water Monitoring Results Certification Form (BSDW-54) to the BWSE within ten (10) days of implementation of the consumer notification requirements.** The Consumer Notice of Lead Tap Water Monitoring Results Certification Form is available at https://www.nj.gov/dep/watersupply/pdf/bsdw54.pdf.

10. Lead service line replacement shall commence **January 1st, 2019** in accordance with 40 CFR 141.84 et seq. and follow the reporting requirements in 40 CFR 141.90(e). **Submit the total number of lead service lines in your water system and a replacement schedule to the BWSE within 60 days of the date of this letter.**

This NOTICE OF NON-COMPLIANCE does not constitute final agency action and may not be appealed or contested. The issuance of this Notice or your compliance therewith does not preclude the State of New Jersey or any of its agencies from initiating formal administrative and/or judicial enforcement action, including assessment of penalties, with respect to the items of non-compliance listed above or for any other violations. Violations of the above regulations are subject to penalties of up to $25,000.00 per day/offense and in the event of formal administrative or enforcement action, you may appeal or contest such action and penalties.

Issued by: Felicia Fieo, Section Chief
Bureau of Safe Drinking Water

Signature: Joseph [illegible] for FF Date: 1/7/19

#/3

M

MOTT M
MACDONALD

To	Eric Vitale, SUEZ
From	Eugene DeStefano, Project Manager – Mott MacDonald John Civardi, Technical Specialist – Mott MacDonald
Our reference	Project #406847
Office	Iselin, NJ
Date	February 5, 2019
Subject	**SUEZ Lead Compliance – Task 3 Corrosion Control Treatment Peer Review** **FINAL TECHNICAL MEMORANDUM**

I. Introduction

This Technical Memorandum deliverable has been prepared in accordance with our scope of services under Task 3 - Corrosion Control Treatment Peer Review. It presents the findings of a peer review of reports and technical memoranda prepared by CDM Smith along with additional data and information developed by SUEZ. These reports, memoranda, along with other data were assembled by SUEZ and furnished to Mott MacDonald.

A summary of the items reviewed including file name and description is provided below:

File Designation	Description of File
SUEZ Haworth WTP Corrosion Test Results 2.2.17.pdf	CDM Smith Report – February 2017
SUEZ Haworth WTP Corrosion Control Recommendations 4.24.17	CDM Smith Report – April 2017
2019003163639.pdf – this is a file with the instructions for customer sampling	Instructions for SUEZ customer sampling
Follow up WQP 2018.wlsx	Xcel spreadsheet from SUEZ with completed follow-up monitoring WQP Data
Hackensack Lead ALE.pptx	PowerPoint presentation from SUEZ describing the lead event

LCR_DataSummary20181219.xlsx	Xcel spreadsheet provided by SUEZ for lead and copper compliance results from 2015 through 2018
Lead Profile Data- 157 Roosevelt Ave Westwood – received 01-14-2019.xlsx	Xcel spreadsheet of lead profile from a Tier 1i site
Re More data and maps.msg – this is an email thread between SUEZ and CDM Smith on the recent data	Series of e-mails between SUEZ and CDM Smith
Rocky Mountain Section 2018 When Life Gives You Lead Ravel Cmmts 2018. Pptx	Mott MacDonald PowerPoint presentation on pipe loop testing given at the 2018 Rocky Mountain Section of AWWA Joint Annual Conference
Routine RTCR Monitoring Map.pdf	Map of RTCR Sampling Sites provided by SUEZ
SUEZ Hackensack 0238001 NONC PB ALE PEA190001 01_072019.docx	Letter from NJDEP notification of ALE exceeded
SUEZ_pH-oPO4.xlsx	Additional pH and orthophosphate distribution system data
Total20152018LeadTestResult.pdf	Maps provided by SUEZ
Total20152018LeadTestResultPressureZone.pdf	Maps provided by SUEZ
Total20152018LeadTestResultHotspot.pdf	Maps provided by SUEZ

This peer review will assist SUEZ in responding to Correction Action Item 4 contained in the NJDEP's letter to SUEZ dated January 7, 2019 (copy attached). This memorandum was prepared with the assistance of Abigail Cantor, President of Process Research Solutions, LLC. Process Research Solutions LLC is a chemical engineering consulting firm specializing in drinking water quality issues. Ms. Cantor is recognized as a national expert in the field of internal corrosion in water distribution systems.

Corrective Action Item 4 from the January 7, 2019 NJDEP letter states:

> "BSDW records indicate that your system uses zinc orthophosphate corrosion inhibitor and sodium hydroxide for pH adjustment for CCT. The recently exceeded AL for lead indicates that the CCT is not optimized. Suez Water New Jersey Hackensack shall evaluate the performance of the CCT and the most recent WQP data to determine appropriate immediate corrective measures to optimize the treatment. **Submit a summary of the evaluation and corrective measures taken to optimize the**

existing treatment to the BWSE within 30 days from the date of this letter. The submittal shall be reviewed, approved and signed by the licensed operator of record.

Please be advised that the BWSE may require additional WQP monitoring based upon the review of your corrective action summary."

II. Evaluation of Corrosion Control Treatment (CCT) and most recent Water Quality Parameters (WQP)

This section presents a chronology of system operation related to corrosion control treatment (through pH adjustment and addition of zinc orthophosphate) along with a discussion of potential water quality, plant and distribution system operational events that could have impacted corrosion control treatment. Also described herein are potential corrective measures.

Chronology

On April 24, 2017, a memorandum was issued by CDM Smith that contained the following dosage recommendation "...it is recommended that SWNJ begin at a lower dose of PO_4 and increase over time to a dose of 1.0 mg/L as PO_4. The dose can be further increased if necessary to reduce soluble lead concentrations based on ongoing monitoring during the implementation phase." It should be noted that CDM Smith's study indicated a point of diminishing returns after 1.0 mg/l.

Regarding pH the April 24, 2017 memorandum stated, "It is recommended that pH be gradually lowered to 7.8 after the orthophosphate system is in operation". In addition, the May 2, 2017 letter from NJDEP, stated "In summary, Suez Water can use the Zinc Orthophosphate inhibitor proposed but it should be noted that the current pH that Suez Water is maintaining may be inefficient. The Bureau strongly recommends that Suez Water either lower the pH to less than 8 or higher than 8.5; a pH of 7.5 is ideal." CDM Smith's CCT study also showed a negligible difference in efficacy between a pH of 7.8 and 7.5.

On October 16, 2017, SUEZ began adding zinc orthophosphate at the Haworth Water Treatment Plant at a dosage of 0.50 mg/L as PO_4. At that time, no change was made to the finished water pH (which was approximately 8.25) at the Haworth Water Treatment Plant.

On January 17, 2018 SUEZ increased the orthophosphate dose to 1.0 mg/L as PO_4. The pH was lowered gradually from 8.0 to 7.6 from approximately May of 2018 to November of 2018.

SUEZ performed Lead and Copper Rule (LCR) customer tap sampling and for the period of July 1, 2017 through December 31, 2017 the 90th percentile lead concentration was 11.4 µg/L, which is below the Lead Action Level (AL) of 15 µg/L.

SUEZ performed LCR customer tap sampling for the period January 1, 2018 through June 30, 2018 and the 90th percentile lead concentration was 10 µg/L which is also below the Lead AL of 15 µg/L.

SUEZ performed LCR customer tap sampling for the period July 1 through December 31, 2018 and the 90th percentile lead concentration was 18.4 µg/L, which exceeds the Lead AL of 15 µg/L.

As part of the required WQP sampling, SUEZ also monitors pH and orthophosphate at the entry point, and pH, orthophosphate, and alkalinity in the distribution system. The entry point at the Upper Saddle River Well only requires pH analysis. Sampling at the entry point is conducted every week and the regulation requires sampling to be performed every 14 days. Sampling is conducted at 50 sites every 6 months in the distribution system.

MOTT MACDONALD

From January 3, 2018 to December 17, 2018 the Haworth Water Treatment Plant Point of Entry pH ranged between 7.3 and 8.2 with an average of 7.8. With respect to the distribution system, pH ranged between 7.01 and 8.15 with an average of 7.68. pH was gradually lowered over time to be closer to average.

With respect to orthophosphate, after January 2018, the Haworth Water Treatment Plant Point of Entry orthophosphate was very stable at an average of 0.32mg/L as P. With respect to the distribution system, orthophosphate was also very stable at most sites, with an average of 0.33 mg/L as P. Note that 1 mg/L as P is equal to 3.065 mg/L as PO_4. Values and units presented for orthophosphate in this memorandum use both designations based on the form in which they were reported.

While orthophosphate levels were stable in much of the system, there were exceptions in two area. Specifically, SUEZ maintains an interconnection with the Jersey City Municipal Utilities Authority (JCMUA). The influence of the JCMUA interconnection serves the SUEZ area encompassing the towns of Secaucus, North Bergen, Union City, Weehawken, Guttenberg, West New York and Edgewater. JCMUA uses orthophosphate at a dose of approximately 1.0 mg/L as P, which tends to elevate orthophosphate concentrations in this area. Conversely the orthophosphate concentration in the area near the Upper Saddle River wells (which are not dosed with orthophosphate) tends to be lower when the wells are on due to blending.

SUEZ has also conducted lead service line profiles from one location -- 157 Roosevelt Avenue in Westwood. This location is a Tier 1i site in the compliance sampling pool. Profiles were conducted approximately monthly with the first event in September 2017 prior to orthophosphate addition. Samples prior to December 2018 were analyzed only for total lead. In December 2018, to better understand the elevated lead levels (see Table 1), SUEZ analyzed samples for both total and dissolved lead.

The results of the December 2018 event are presented in Table 1 below:

Table 1 - Lead Profile

27/12/2018			TOTAL	DISSOLVED
LAB ID NO.	SAMPLE COLLECTION	ML OF SAMPLE	RESULT (pp	RESULT (ppb)
	27/12/2018	1001-2000	19.9	8.16
	27/12/2018	2001-3000	44.8	22
	27/12/2018	3001-4000	45.6	17.6
	27/12/2018	4001-5000	21.6	6.85
	27/12/2018	5001-6000	11.5	3.15

The Table 1 data indicate that more than 50% of the lead concentration in the water was in particulate form. For example, in the first liter 8.16 ppb was dissolved resulting in a particulate lead concentration of 11.74 ppb (11.4/19.9 = 58.9%). Generally, orthophosphate is aimed at lowering dissolved lead and is less effective for reducing particulate lead.

MOTT MACDONALD

Plant and Distribution System Operational Events

Plant and distribution system operation could potentially impact lead levels in the distribution system. Except for October, five of six months from the period from July 1 through December 30, 2018 experienced greater precipitation than 2017 and five months were above the historical monthly average. Below is a summary of the 2017 and 2018 rainfall data as compared to historical monthly mean.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2017	4.65	2.09	5.07	3.49	7.24	5.29	4.36	5.49	1.72	4.94	1.51	1.64	47.49
2018	2.06	5.74	4.48	5.85	3.80	1.87	6.30	5.87	5.64	2.82	7.95	7.09	59.47
Mean	3.40	2.94	4.02	3.74	3.90	3.65	4.17	4.15	3.77	3.27	3.56	3.55	44.29

Rainfall could potentially impact the water treatment process and finished water quality. We suggest that monitoring should be conducted for at least twelve consecutive months to better assess the impact of rainfall on treatment and finished water quality.

The SUEZ system also uses chloramination for secondary disinfection. In other monitoring studies (Water Research Foundation Project 4586 described later), it has been found that chloramination can lead to varying degrees of seasonal nitrification in the distribution system with related release of dissolved lead in the warmer months and particulate lead in the fall. In addition, changes in finished water chemistry, such as pH, can impact the effectiveness of chloramination as a disinfectant, allowing for an increase in microbiologically influenced corrosion of metals.

Operation of the valves in the distribution system can affect release of particulates. Particulates from iron, manganese, or aluminum scales on pipe walls are a potential pathway for mobilizing particulate lead. In addition, hydraulic disturbances in water systems, such as water main breaks or fire flows, can disturb existing scale accumulations on pipe walls, releasing particulates into the water. When scale particulates enter building plumbing with potential lead sources and lead compounds on pipe walls, the scale particulates can serve as a mechanism to transport lead to consumers' faucets. Table 2 provided by SUEZ presents a summary of the lead AL exceedances in the second period of 2018. Distribution system activity and disruption dates are also noted in the table.

Table 2 Action Level Exceedances

ADDRESS	LEAD (PPB)	COLLECTION DATE	DISTRIBUTION ACTIVITY	DISRUPTION DATE
[redacted] Carlstadt	62	9/28/2018	HYDRANT TESTING	9/24/2018
[redacted] East Rutherford	33.5	10/22/2018	LARGE MAIN ISOLATION	10/3/2018
[redacted] Bogota	15.4	10/20/2018	MAIN BREAK	9/10/2018
[redacted] Englewood	31.2	10/18/2018	MAIN BREAK	11/29/2018
[redacted] Old Tappan	76.1	10/25/2018	LARGE MAIN ISOLATION	9/26/2018
[redacted] Leonia	159	11/5/2018	MAIN BREAK	11/2/2018
[redacted] Rutherford	29.6	10/31/2018	LARGE MAIN ISOLATION	10/3/2018
[redacted] Hackensack	20.2	11/3/2018	HYDRANT TESTING	10/31/2018
[redacted] Hackensack	27.2	11/6/2018	HYDRANT TESTING	10/31/2018
[redacted] Englewood	15.9	11/7/2018	MAIN BREAK	11/29/2018
[redacted] Bogota	16.9	11/1/2018	MAIN BREAK	9/10/2018
[redacted] Ridgefield	18.1	11/14/2018	LARGE MAIN ISOLATION	10/3/2018
[redacted] Rutherford	19.4	11/20/2018	LARGE MAIN ISOLATION	10/3/2018
[redacted] Harrington Park	217	9/13/2018	LARGE MAIN ISOLATION	8/17/2018
[redacted] Westwood	17.5	9/15/2018	MAIN BREAK	8/28/2018
[redacted] Rutherford	73.9	12/5/2018	LEAK REPAIR	11/23/2018

Customer Sampling Errors/Change of Sampling Sites

SUEZ is conducting site visits at each home that exceeded the action level to minimize sampling errors. On the site visit to 49 Tappan, Harrington Park, it was determined that the customer does not live in the house so at times the site is vacant. It is believed that this situation may have resulted in extended stagnation periods contributing to the high result captured at the residence.

In addition, SUEZ conducted site investigations from July through December of 2018 to gather information regarding the curb to building materials and lead solder presence. During these site visits certain sites in the pool were deemed lower tiers based upon the findings, thus alternate sites were activated. Most of the high sites were "new" having not been sampled before.

Proposed Corrective Measures Taken to Optimize Existing Treatment

Based on the above observations, this section describes the proposed corrective measures to be taken to optimize treatment.

The CDM Smith April 24, 2017 memorandum noted the following:

"The dose can be further increased if necessary, to reduce soluble lead concentrations based on ongoing monitoring during the implementation phase." It was also recommended by the NJDEP, that the EPA optimized corrosion control treatment (OCCT) template be used to troubleshoot the lead exceedance. The OCCT template is shown in Table 3. However, the potential for transport of lead by means of pipe wall scales and the corrosion and release of lead by means of microbiologically influenced corrosion has been described earlier in this memorandum. The EPA template does not consider these mechanisms of lead release and transport. Therefore, it would be premature to increase orthophosphate dosing and/or lower pH until the other factors can be addressed in the water system. Additional data and exploration are needed.

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Hence, the following potential mechanisms of lead release and transport need to be addressed in an OCCT study:

- Transport of lead by means of disturbed existing pipe wall scale particulate matter
- Release of particulate lead by means of sloughed biofilm in the fall
- Release of dissolved lead by means of nitrification in the later summer months

We recognize that the NJDEP is requiring a revised OCCT by June 30, 2019. However, as noted earlier, corrosivity can be significantly impacted by seasonal changes to water quality. Therefore, additional testing through the end of 2019 is recommended. We suggest that SUEZ request an extension to submit the OCCT by October 31, 2019. It should be recognized that additional testing would continue past October 31, 2019. This additional testing is described below and could result in additional modifications to the OCCT recommendations.

Table 3 The US EPA Optimized Corrosion Control Treatment

Exhibit G.5 Setting OWQPs for Orthophosphate Inhibitor Addition		
Step 1: Is the residual orthophosphate level in the distribution system $\geq$ 1.0 mg P/L (> 3.0 mg/L PO_4)?	YES	Go to Step 2.
	NO	If system has recommended an orthophosphate residual in the distribution system that is < 1.0 mg P/L, then determine if inhibitor chemical dosage needs to be increased to provide optimal reduction in lead and/or copper levels. If system has recommended an orthophosphate residual in the distribution system that is $\geq$ 1.0 mg P/L, then evaluate orthophosphate demand in the system (difference between entry point orthophosphate versus residual orthophosphate in the distribution system) and potential for adjusting required dosage to meet recommended residual in the distribution system.

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Step 2: Are the minimum pH values measured at the Entry Point > 7.2 pH units?	YES	Go to Step 3.
	NO	Minimum pH should be higher for orthophosphate use. Have system re-evaluate pH adjustment process, or raise pH if 7.2 or below.
Step 3: Is the distribution system pH between 7.2 and 7.8 pH units?	YES	Go to Step 4.
	NO	The pH is not in the optimal range for use of orthophosphate inhibitors. Have system re-evaluate the pH control treatment process, pH variability in the distribution system, and adequacy of recommended orthophosphate dosage and residual in the distribution system.
Step 4: Is the range of pH values measured at the entry point < 0.4 pH units (Range = max entry point pH - min entry point pH)?	YES	Go to Step 5.
	NO	The pH may be too variable for effective corrosion control. System should re-evaluate the pH adjustment process (i.e., review process control charts and operations).
Step 5: Is the range of pH values measured in the distribution system < 0.6 pH units (Range = Max distribution pH - Min distribution pH)?	YES	Identify OWQP minimums and ranges based on existing information (both regulatory WQP monitoring data and additional diagnostic monitoring data if available).
	NO	Evaluate causes for pH variability in the system. Evaluate buffer intensity, distribution system materials, and distribution system operations, and adjust treatment and operations to achieve a narrower range of pH and alkalinity.

Source: US EPA (March 2016)

Prior to making any changes to the water treatment process, the mechanisms of dissolved and particulate lead corrosion and release as well as the EPA considerations from Table 3 should be studied using an enhanced sampling program. This sampling program should also mitigate potential simultaneous compliance issues associated with any changes such as: increased microbial activity, DBP issues, nitrification, and discolored water issues. This holistic approach to distribution system water quality is described in "Water Research Foundation Project 4586, Optimization of Phosphorus-Based Corrosion Control Chemicals Using a Comprehensive Perspective of Water Quality". A distribution system monitoring plan is being developed under Task 4 and it may consist of:

- Lead and Copper monitoring stations and/or pipe loops located at the Haworth Water Treatment Plant and in locations in the distribution system in areas with lead action level exceedances and in areas with lead levels significantly below the 15 ug/L action level. (e.g. <5 ug/L)
- Enhanced monitoring using Revised Total Coliform Rule (RTCR) sites to determine the impact of potential parameters such as:
    - Chloride
    - Sulfate
    - Total organic carbon
    - Biological parameters such as ATP and newly developed testing methods for biological parameters
    - Free and total chlorine
    - Free ammonia
    - Nitrate and nitrite
    - pH
    - alkalinity

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- Enhanced monitoring of the Haworth Water Treatment Plant effluent for similar parameters as the RTCR sites.

- Continued performance of the lead service line profile at 157 Roosevelt Ave and consideration of performance of at least one additional location monthly.

- Performance of scale analysis of harvest lead pipe. The analysis will describe the minerology and potentially biological scales and will assist in evaluating potential corrective actions.

I. SUMMARY OF FINDINGS, CONCLUSIONS AND INITIAL RECOMMENDATIONS

The following is a summary of the findings, conclusions and recommendations.

Findings

- Zinc orthophosphate addition began in October 2017 at approximately 0.5 mg/L as PO_4
- The zinc orthophosphate dose was raised to approximately 1.0 mg/L as PO_4 in January 2018 and pH has been gradually lowered.
- Neither the second monitoring period in 2017, nor the first monitoring period in 2018 had a lead AL exceedance (90th percentile was 10 ug/L)
- The second monitoring period in 2018 had a lead AL exceedance (90th percentile was 18 ug/L).
- Distribution system phosphate concentrations in the system are stable with the exception to two POE locations as discussed in this memorandum.
- Based on a single lead profile conducted at the same home in December 2018, approximately 50% of the lead is particulate.
- Rainfall in 2018 was significantly higher than previous years. Rainfall may have an impact on source water quality. Treatment changes in response to source water quality can impact corrosivity.
- Disruptions in the distribution system as noted in Table 2 and chloramination treatment can impact corrosivity.

Conclusions

- There does not appear to be an immediate readily-definable cause of the lead AL exceedance in the second monitoring period of 2018.

Initial Recommendations

- To optimize corrosion control, additional plant effluent and distribution system water quality monitoring is necessary. Seasonal variations in plant effluent and distribution system water quality can significantly impact corrosion and distribution system monitoring should be conducted for at least twelve consecutive months.
- Based on the data obtained from the sampling, potential solutions will be identified and evaluated.
- The potential solutions will be assessed considering simultaneous compliance issues so that improvements to corrosion do not have adverse regulatory impacts on distribution system water quality (e.g. lowering pH could impact the stability of chlorine residual).
- Due to the complex chemistry associated with lead corrosion and the need to conduct additional sampling and analysis, it would be premature to make immediate adjustment to the current pH and orthophosphate dose.